2013 – 2016 BUSINESS PLAN

Alberta

Alberta Innovates
Energy and Environment Solutions

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EXECUTIVE SUMMARY

"Desired environmental outcomes for air, land, water and biodiversity are achieved."
"Sustainable natural resource development is achieved."

Goals outlined in Enterprise and Advanced Education 2013 – 2016 Business Plan

CORE BUSINESS

Our **core business** is to Position Alberta to achieve superior environmental performance while growing and diversifying the energy economy. This will ensure that Alberta continues to lead the country in exports, job growth and wealth generation in support of economic and social well-being of Albertans and Canadians.

STRATEGIC CONTEXT

Alberta's energy sector underpins Canada's economy, accounting for $60 billion in exports, more than any other single export sector in the country. The province relies on the energy industry for much of its prosperity. It typically accounts for almost 20 per cent of total Alberta output (GDP or value added) and almost half of the economy when indirect contributions are also included.[1] It is anticipated approximately $169 billion[2] will be invested in the industry in the next two decades. In 2011-12, revenue from oil sands and conventional oil is the major part of Alberta's non-renewable resource revenue and this trend is expected to continue.

Alberta is part of the global economy, and the province faces many challenges in the energy and environment sphere. We are affected by global markets, the price of oil and natural gas, the desire for a clean environment, the perceptions of a skeptical public, and changing social values. For this reason, it is imperative that our natural resources are developed cleanly and with minimal impact on the environment, which includes responding to the call to lower greenhouse gas (GHG), emissions, managing oil sands tailings ponds and the overall use and disposal of water especially ensuring high standards of water quality in rural areas.

Alberta Innovates – Energy and Environment Solutions (AI-EES) is a part of Alberta Innovates, a collaborative system built on a strong legacy and proven success. As the ***"... research, innovation and technology implementation arm of the Government of Alberta ministries in***

[1] Statistics Canada CANSIM< Table 379-0025 and Alberta Chamber of Resources, Task Force on Resource Development and the Economy, 2011, Section 3.
[2] Inventory of Major Capital Projects, www.albertacanada.com/business /statistics/inventory-of-major-capital-projects, table created March 11, 2013.

energy and environment,"[3] AI-EES' focus is to bring together decision makers from government and industry, as well as research and innovation technology organizations, to develop solutions for the key technical challenges facing Alberta's energy, environment and water sectors.

Within this Strategic Business Plan, you will read about our purpose, priorities and goals. We will also share insights on new research, technology developments and projects that could change the way people think about responsible energy development, the oil sands, clean energy and more effective management of Green House Gas (GHG) emissions and water. You will also gain an understanding of how we are working to implement the goals of the province's strategies in energy, climate change and water. In 2013 to 2016, AI-EES will continue to take bold actions to position Alberta to achieve superior environmental performance while growing and diversifying the energy economy. Strong leadership and vision from the Government is critical for success.

MAJOR BUSINESS STRATEGY FOR 2013-16

Inclusive Innovation Dialogue

Today, societal values are changing dramatically and have become a major influence on the Alberta economy and public policy. Some believe social media has created a greater forum for dialogue and raised the profile of public opinion. Regardless of the reason why, views about such things as pipeline development, rural water supplies and management and future oil sands development, have formed a major part of the public dialogue, and in turn, changed the way such projects are implemented. Without a good understanding of societal values and their influence on a project or program outcome, an organization can invest time and resources following a path that will not be accepted by public stakeholders.

In our 2012-2016 Strategic Business Plan and in developing what we called "the Improved AOSTRA Model", we recognized the importance for understanding as well as tackling the complex social and environmental issues in the context of the provincial interests.

In 2013, working with key Alberta Ministries, industry and research partners, a comprehensive strategic plan for Inclusive Innovation Dialogues will be developed and the strategy will be pilot tested and refined before launching a full scale program. The purpose of these dialogues is to encourage mature, constructive conversation amongst the public, First Nations and non-government organizations based on the science of solutions. The overall objective is to support and enhance the legitimacy and the practicability of policy and regulatory requirements through better integration of public values based on the best available technical knowledge.

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[3] Mandate and Roles Document - http://ai-ees.ca/media/7985/mandate_and_roles_of_ai-ees_100331_final.pdf

MANDATE

The Mandate and Roles Document for Alberta Innovates – Energy and Environment Solutions ("AI-EES") has been developed collaboratively between the Minister of Advanced Education and Technology and AI-EES to reflect a common understanding of their respective roles and responsibilities.

AI-EES will serve as the research, innovation and technology implementation arm for Government of Alberta ministries in energy and environment, applying world-class research and innovation management strategies to preserve and enhance Alberta's economic, environmental and social well-being.

The Government of Alberta has given AI-EES the following responsibilities as set forth in the *Alberta Research and Innovation Regulation:*

- To support, for the economic and social well-being of Albertans, energy and environment research and innovation activities aligned to meet Government of Alberta priorities, including, without limitation, activities directed at the development and growth of the energy and environment sectors, the discovery of new knowledge and the application of that knowledge.

AI-EES will create value through:

- Increased effectiveness and integration of planning, funding and delivery of research and innovation programs
- Alignment of programs and investments toward priority areas and outcomes
- Improved facilitation of knowledge, intellectual property, technology and skill transfer within the system, and between academia, industry and government
- Improved accountability and outcomes through integrated performance monitoring and continuous improvement processes
- An integrated and disciplined research and innovation process to inform government policy and regulations for sustainable development.

Core competency and differentiating AI-EES

AI-EES has had a unique history and a cultural development inherited from its predecessor organizations, AOSTRA, AERI and AWRI and is built on independent thinking and competencies where technical skills are combined with networking and collaboration skills to support Alberta government priorities. The staff are technically experienced in the program areas of AI-EES' focus and have the required core competencies of identifying, evaluating and selecting

technologies and partners for initiatives that position Alberta for the future in energy and environment. They are also well connected with industry and government and possess the corporate memory needed to ensure that initiatives are efficient, effective and relevant.

AI-EES has also developed the management and evaluation tools including engaging consulting engineering companies to enable it to make rational decisions on how it deploys its internal resources and selects initiatives.

The Board Members of AI-EES were especially selected for their business acumen, operational and governance experience and strategic thinking. Collectively the Board provides the needed oversight so that decisions are made in the best possible light.

Key elements of our business model

AI-EES promotes the implementation of energy and environmental technologies in Alberta and will conduct its activities with the following specific goals:

- Define and focus on areas and programs of strategic importance to sustainable development of Alberta's hydrocarbon and renewable energy industries
- Identify technology platforms capable of accelerating the development of game-changing technologies and innovation in one or more of the strategic areas
- Develop core technical and business capability and expertise in the strategic programs and technology platforms
- Identify critical technology and innovation gaps impeding game-changing developments
- Monitor technology sources world-wide (competitive intelligence)
- Identify leading technologies and expertise capable of filling the technology and innovation gaps
- Define SMART[4] objectives and formulate development plans for breakthrough technologies
- Evaluate the projects on an Impact-Achievability grid and develop a balanced portfolio of projects at different "Technology Readiness Levels" (TRL)
- Select qualified technology, first adopter and funding partners
- Execute well-managed stage-gated projects that advance the TRL of selected technologies and build research and technology development capability in Alberta.

[4] SMART: Specific, Measurable, Actionable, Realistic and Timely

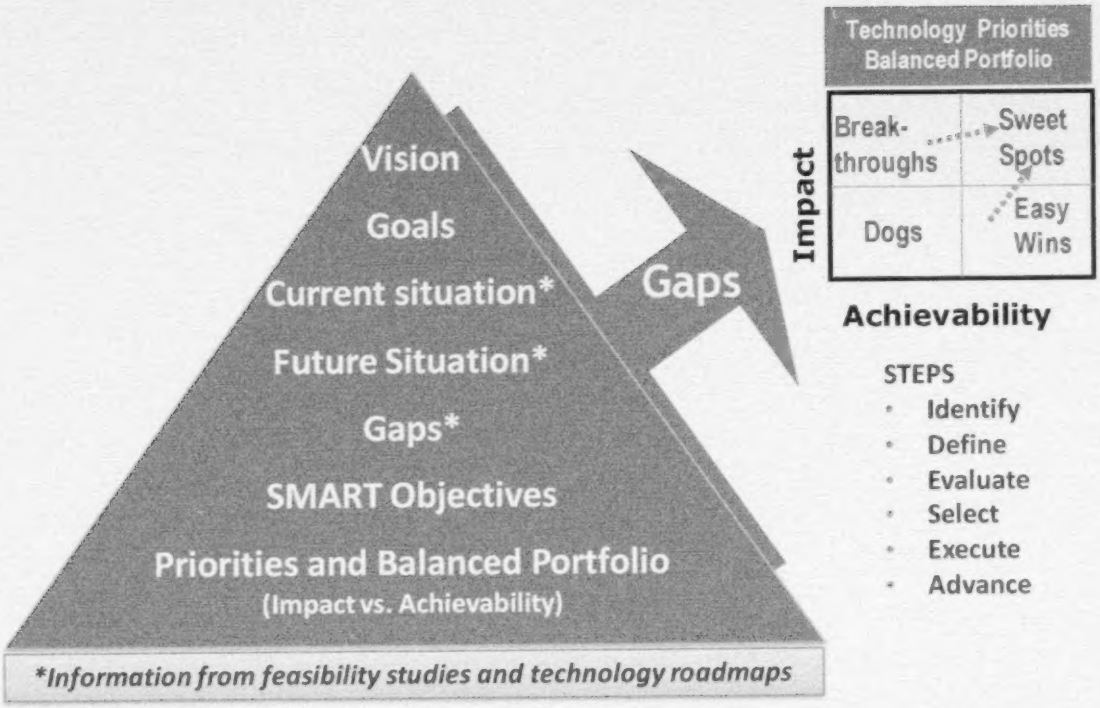
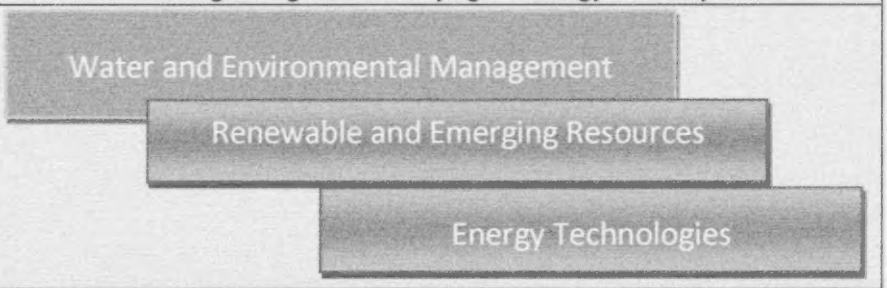


Figure 1: *Schematic illustrating the gap analysis process and developing priorities and balanced portfolio.*

HOW AI-EES SUPPORTS THE GOA VISION

The table below is an at a glance view of how AI-EES supports and advances the Government of Alberta Vision.

GoA Vision	Invest in families and communities	Advance world-leading resource stewardship	Secure Alberta's economic future
Triple Bottom Line	Social	Environment	Economic
Alberta's Key Outcomes	Resilient Health Communities	Effective Resource and Environmental Management	Broadened Economic Base

AI-EES Core business	**AI-EES is positioning Alberta to achieve superior environmental performance while growing and diversifying the energy economy.**		
AI-EES Strategic Areas (Bars indicate relevance to the three tenets of the GoA Vision)			
AI-EES Targets Investment decisions typically tied to meeting targets. AI-EES, industry, researchers, and entrepreneurs work together to achieve these targets.	**Healthy and resilient communities**	**Environmental management**	**Economy**
	▪ 30% increase in water efficiency	▪ 50% reduction of GHG emissions on a per equivalent barrel basis ▪ 20% reduction in energy consumed in the production of bitumen ▪ 100 million m^3 reduction from legacy mature fine tailings	▪ 20% of energy is derived from renewable resources ▪ Coal-fired power plants in Alberta at a natural gas equivalent
	Commercial and Next-Generation		
	▪ 3.0 million barrels per day of heavy oil and bitumen production ▪ 20% increase in conventional oil recovery ▪ 15% of gas will come from non-conventional sources		

AI-EES MAJOR PROGRAM AREAS

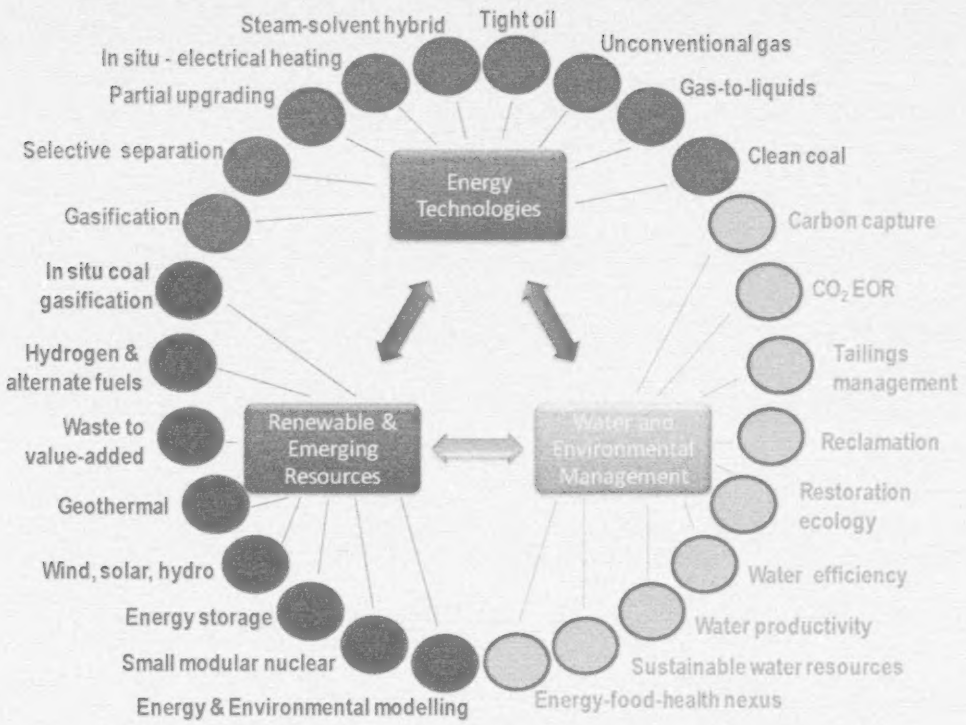


***Figure 2**: Schematic showing program areas and watching briefs in AI-EES three strategic areas.*

FLAGSHIP INITIATIVES IN STRATEGIC AREAS

AI-EES has a long history of success as a catalyst to convert Alberta's natural resources into market-ready, environmentally responsible energy. AI-EES has three strategic theme areas and the following are examples of flagship initiatives that are being pursued and will become fully active in 2013-14:

Energy Technologies

- Pilot(s) advancing lower carbon bitumen recovery technologies using steam, electromagnetic heating and solvents in sandstone and carbonate reservoirs
- Field upgrading demonstration having high yield and removing the need for diluents

Renewable and Emerging Resources:

- Produce syngas from deep fossil energy resources through in situ gasification in order to generate power, hydrogen, liquid fuels and petrochemicals

- Support the development of a vibrant waste utilization industry which contributes substantially to Alberta's supply of renewable energy and economic diversity through the production of bioenergy and novel value-added products.

Water and Environmental Management:

- Field testing of tailings reclamation and water treatment technologies
- Testing advanced carbon capture technologies to reduce Carbon Capture and Storage costs and enable CO_2 enhanced oil recovery
- Integrated land management and biodiversity conversation to improve the understanding and practices in integrated land management and biodiversity conservation in oil sands region
- Water Resources Sustainability
    - Water Security, Risk and Vulnerability
    - Watershed Stewardship and Ecosystem Management
    - Increased Conservation, Efficiency and Productivity.

RESULTS BASED BUDGETING

The Results-Based Budgeting (RBB) Act went into law in March 2012 and required the Government to undertake a comprehensive review of the programs and services provided by the Government and its agencies. The review includes an assessment as to whether the programs and services meet their intended objectives and whether they are being delivered in an efficient and effective manner. The RBB process is used as an approach for deciding the budget for that program or service.

AI-EES was among 46 units across eight ministries (accounting for $600 million of expenses) that responded to a detailed questionnaire designed to assess the **relevance**, **effectiveness** and **efficiency** of each of the units. All 46 units were assigned to the "Economic Development Line of Business" and are the first units to undergo the RBB review.

AI-EES responded to the three main categories/outcomes that are being assessed namely, **Market Access**, **Diversification** and **Value Added**. AI-EES also provided additional supplementary materials to illustrate how AI-EES is supporting government priorities and specific outcomes.

BASIS FOR ORGANIZATIONAL OBJECTIVES

Our **core business** is to Position Alberta to achieve superior environmental performance while growing and diversifying the energy economy. This will ensure that Alberta continues to lead the country in exports, job growth and wealth generation. The figure below demonstrates the enormous contribution that the energy sector in Alberta makes to the Canadian economy[5].

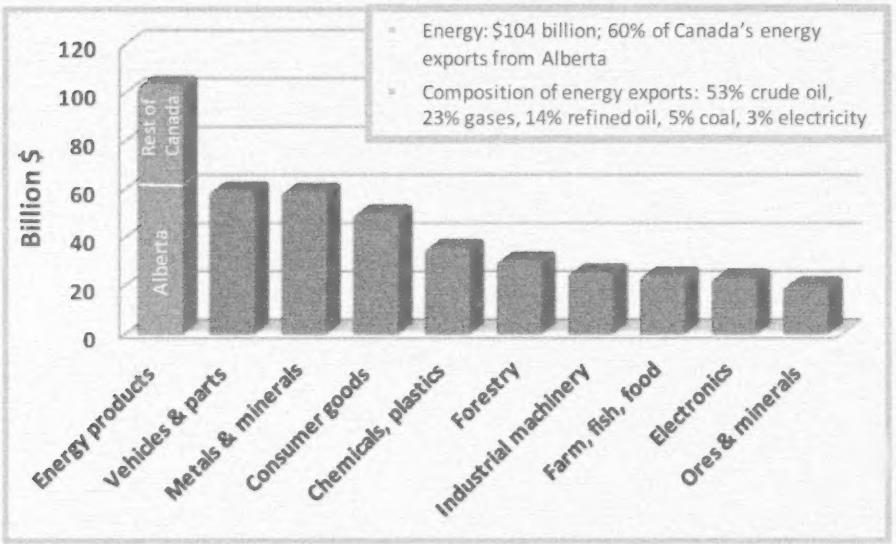


Figure 3: *Graphical representation of the value of the annual Canadian exports in 2012. Source: Statistics Canada, CANSIM, table 228-0059. Last modified: 2013-01-11*

As set forth in the Alberta Research and Innovation regulation, AI-EES is responsible to *"To support, for the economic and social well-being of Albertans, energy and environment research and innovation activities aligned to Government of Alberta priorities, including, without limitation, activities directed at the development and growth of the energy and environment sectors, the discovery of new knowledge and the application of that knowledge."*

The capacity to innovate will be crucial to maintain and grow the enormous potential for Alberta's resources. As the "... research, innovation and technology implementation arm of the

[5] In terms of Net Positive (exports - imports) Industries, Energy Products is at 54% with Metals/Minerals, Forestry, Agriculture making up the balance.

Government of Alberta ministries in energy and environment,"[6] AI-EES' focus is on positioning Alberta to achieve superior environmental performance while growing and diversifying the energy economy in support of sustainable social and economic well-being for Albertans and Canadians.

KEY CHALLENGES

The province is affected by the current global economic uncertainty and unprecedented risks due to commodity volatility and market access combined with a fast-growing environmental consciousness and push towards clean energy and clean water and sustainable development. AI-EES strategic goals and initiatives are informed by the key issues affecting Alberta's competitiveness and environmental challenges including:

Oil sands

- Price differential from the world price to the price Alberta receives impacts the revenue streams of government, and therefore the services that government provides to Albertans
- Getting higher value from bitumen derived products in US refineries since the value loss is estimated to be over $10 billion per annum for Alberta
- The weakness of European and U.S. economies and the decline in transportation fuel demand in North America
- Growing volumes of high quality competitive tight oil, shale oil and unconventional gas
- Increasing resistance to pipeline transportation of dilbit (bitumen diluted with light hydrocarbons)
- Lack of cost effective technology to maximize oil sands market value, and product marketability in current U.S. and future East Coast and Asian markets
- Surface mining of oil sands generates a large quantity of mature fine tailings or MFT (approaching one billion cubic meters). Tailings water is deleterious and needs to be suitably reused or disposed

[6] AI-EES Mandate and Roles Document http://ai-ees.ca/media/7985/mandate_and_roles_of_ai-ees_100331_final.pdf

Clean Energy

- Global push to lower carbon energy sources and Federal regulation casting the spotlight on the higher carbon content fuels especially coal and the oil sands resources
- Alberta has large volumes of stranded low priced natural gas as a result of surge in shale gas production that can be used to produce cleaner transportation fuels
- Alberta has world class deep coal resources but require the development of commercial underground coal gasification technology to exploit them cleanly
- The slow pace for commercial-scale carbon capture, utilization and storage
- The lack of uptake of carbon dioxide enhanced oil recovery in Alberta
- Alberta has tremendous potential for capturing waste heat from industrial sources but energy efficiency technologies are often costly
- Alberta is not taking advantage of growing investments in clean technology ("cleantech"[7]) sector

Renewable resources

- Alberta has vast renewable energy resources, which have yet to be developed
- High labour costs in Alberta coupled with subsidies for renewable energy in other jurisdictions represent barriers to growth of a renewable portfolio in Alberta
- Alberta's manufacturing based is currently dedicated to the oil and gas sector
- Alberta is one of the highest per capita waste producers in the world with the vast majority of waste ending in landfills
- Deployment of small nuclear reactors for the generation of electricity and process heat are decades away from commercial applications in Alberta

Water

- Fresh water is becoming increasingly scarce in Southern Alberta and is a barrier to community development and economic expansion
- Water for industrial development, agriculture, oil and gas and biofuels production will require a rational science-based approach to the use of water for fuel, food and health
- Global warming is believed to be the cause of the retreat of glaciers and more frequent droughts. This poses a threat to future water supply in both South and North areas of Alberta, with the potential for significant adverse economic impacts

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[7] Cleantech is any product or services that improves operational performance, productivity, or efficiency while reducing costs, inputs, energy consumption, waste, or environmental pollution. Cleantech is often associated with venture capital funds and land use organizations.

These trends demonstrate the need for strong leadership and vision from the Government. As new fuels and energy sources are developed and promoted, Canadian and world markets are turning to alternative suppliers. Alberta needs to act now to ensure its long term prosperity. The elevated importance for environmental performance, especially controlling GHG emissions and water use, is critical for Alberta's future economic growth.

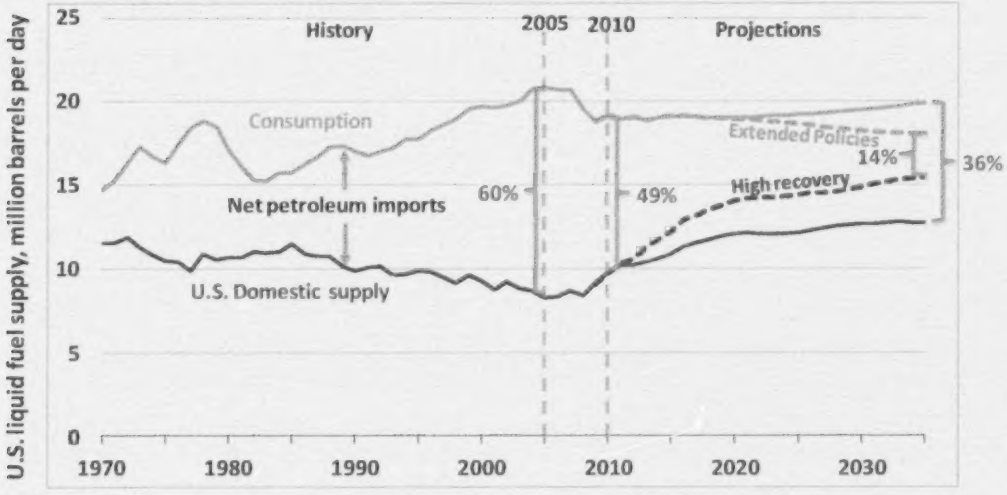

***Figure 4**: The U.S. dependence on imported petroleum has declined and is projected to continue to decline replaced by the fast growing volumes of high quality domestic crudes. This implies that the "bitumen bubble" is likely to continue for some time. (Source: EIA, Annual Energy Outlook 2012)*

BASIC STRATEGIC APPROACH

Relevance: Initiatives have to first and foremost be relevant to Alberta and Albertans

International Caliber: Initiatives must stand up to scientific and engineering rigor and high standards

Step Change: Initiatives are designed to meet Alberta's priorities, stretch targets and goals and support policy development

The above forms the basis of AI-EES' investments, how AI-EES deploys its internal resources and selects the management and evaluation tools to evaluate initiatives and evaluate its performance.

MONITORING FOR SUCCESS

AI-EES is investing taxpayer's dollars in projects. It is imperative that the maximum value of those investments be realized. The best way to do this is to take a very hands-on approach to project monitoring. AI-EES creates a steering committee for all projects it invests in; personnel sit on the steering committees and regularly interact with project performers; and the organization receives regular project reports. AI-EES does not release funds until reports are read and analyzed by staff. This applies to all CCEMC funded projects as well.

This process requires that staff have detailed knowledge in their area of expertise, so that they are seen as important additions to a project steering committee team. This requires that key personnel in AI-EES have advanced degrees and have developed a reputation built on trust and knowledge with their peers. Large pilot projects, in which investments of several millions of dollars are made, require weekly and sometimes daily communications with the research performer to ensure that the project has what it needs to be operationally successful. Therefore, adequate staff and a network of consultants are required to do this task correctly and to ensure the safeguarding of government investments.

COLLABORATIONS ARE OUR COMPETITIVE ADVANTAGE

a. Government of Alberta Departments

AI-EES has established working committees with government departments (includes Enterprise and Advanced Education, Energy and Environment and Sustainable Resource Development) to discuss specific issues and opportunities involving energy and environment research and innovation and to develop projects that will benefit all parties. AI-EES has staff members that regularly meet with counterparts in other departments to delve into opportunities for co-sponsorship of projects. AI-EES has a strong track record of working with other departments on several initiatives, including Carbon Capture and Storage, Advanced Recovery Pilots, Bitumen Royalty In Kind, Life Cycle Analysis and ecoTrust.

b. Relevant GOA Policies and Strategies

AI-EES has studied the following relevant government strategies and identified areas where there are synergies and gaps. By working with the government department responsible for each, AI-EES will build opportunities for future work.

- *Alberta Research and Innovation Plan*, updated yearly
- *Provincial Energy Strategy*, December 2008
- *Responsible Actions: A Plan for Alberta's Oil Sands,* February 2009
- *Alberta's 2008 Climate Change Strategy,* January 2008

- *Renewed Water for Life Strategy,* November 2008
- *Tailings Management Framework,* (in development)
- *Land-use Framework,* December 2008
- *Alberta Nanotechnology Strategy,* April 2007
- *Directive 074 – Tailings Performance Criteria and Requirements for Oil Sands Mining Scheme,* February 2009
- *Shaping the Future,* Report of the Premier's Council for Economic Strategy, May 2011

c. Research, Analysis and Technology Informing Policy

To build and enhance collaboration and leverage resources, AI-EES developed a Memorandum of Understanding with Energy, Environment and Sustainable Resource Development, and Enterprise and Advanced Education to create a formal mechanism called "Technology Informing Policy" (TIP) for facilitating, coordinating and promoting technology innovations, which are important from a policy development and strategic business planning perspective.

This mechanism provides the framework for AI-EES to work with key GOA departments to ensure that policy decisions and strategies are informed by sound technical analysis. AI-EES and the departments are involved at all stages of the process. Following are examples of the work that the TIP committee is currently doing.

GHG MANAGEMENT RELATED

Strategic Context/ GoA Priorities	Project	How Does the Project Fit in the Strategic Context in Alberta
• **GHG emission in AB, particularly from oil sands development continues to be a concern** • **2008 Climate Change Strategy is being reviewed (ESRD)** • **Potential of CCS is being questioned** • **CO_2 – EOR is considered as a means for carbon storage (ADOE)**	Optimizing strategies GHG emissions reduction (Hatch)	Pre-screen promising options for meeting overall GoA's objective in GHG reduction Provide a perspective on the path forward with respect to adopting and implementing a systems analysis approach for this challenge
	Evaluating the role of CCS for GHG reductions in oil sands (Pembina)	Address the realistic potential of CCS in reducing GHG emission for OS industry Focus on assessing technology readiness level (TRL) of carbon capture
	Overcoming barriers for CO_2 EOR in AB (Gunter)	Understand the barriers in CO_2-EOR development in Alberta Help to make it happen in Alberta
	ECM and SOFC for CHP and Carbon Capture in SAGD	Part of the effort to remove the barrier in CCS by looking for technologies in carbon capture

MARKET ACCESS RELATED

Strategic Context/ GoA Priorities	Project	How Does the Project Fit in the Strategic Context in Alberta
• **Market access is the root cause for "bitumen bubble"** • **The province is losing billions of dollars revenue** • **GoA is looking for market diversification**	Properties and Corrosivity of Dilbit (AITF)	Address safety concerns related to dilbit transportation Provide scientific data and information on the nature of dilbit and its safety in transportation for GoA and US stakeholders.
	Pipeline Knowledge Network, Gap Analysis and Roadmap (PTAC/UoC)	Provide GoA and the industry (CEPA) members a clear understanding of the knowledge network, knowledge gaps, and roadmap to close the gaps in hydrocarbon transportation

Strategic Context/ GoA Priorities	Project	How Does the Project Fit in the Strategic Context in Alberta
	Market Study PADD II (Jacobs)	Understand potential options for improving the competitive position of Alberta's Oil Sands products in PADD II refineries and identify technology options to improve quality & competiveness.
	Market Study Eastern Canada (IHS CERA)	To assess the volumes of oil sands crudes that can be transported to Eastern Canadian and US Refineries
	Market Access Asian Pacific (Japan Energy Economic Institute)	Update of a 2004 study to assess the volumes and quality of oil sands derived products that can be moved to Far east refineries

SUSTAINABLE DEVELOPMENT OF OIL SANDS RELATED

Strategic Context/GoA Priorities	Project	How Does the Project Fit in the Strategic Context in Alberta
• **GoA is committed to the sustainable development of oil sands** • **Environmental impacts of oil sands development continue to be a major concern in the region and internationally** • **Reducing environmental impacts can help removing barriers for market access** • **Environmental monitoring is a GoA priority**	Tailings technology deployment roadmap	Evaluate existing and emerging technologies for tailings management with the objective to expedite the technology development and deployment
	Thermal in-situ water conservation study	Study the trade-off between water recycling and GHG emission. Identify opportunities for GHG reduction and water conservation in SAGD
	Linear disturbance reclamation (Nielson)	Develop the understanding, tool, and process to reclaim linear disturbance in oil sands developments
	Biodiversity chairs (Boutin/Nielson)	Develop the understanding; predict biodiversity responses to disturbance in oil sands development. Develop restoration methods and tools to recover site biodiversity and landscape processes
	Atmospheric Metal/Organic Deposition in NE Alberta (Shotyk, Larter, Martin)	Determine the background values and industrial contributions of metal and organic deposition in oil sands region in the past 60 years.

		Inform GoA and other stakeholders the real contaminant contribution from oil sands development
	Advanced DIAL instrument for air monitoring	Develop a new instrument to measure PM, CO_2, and methane emission at ground level over kilometer ranges

d. Climate Change and Emissions Management Corporation (CCEMC)

AI-EES provides strategic advice, technology adjudication and project management for the Climate Change and Emissions Management Corporation (CCEMC). AI-EES is intimately involved with, and has staff assigned to participate in, all of the CCEMC funded projects and programs. In many cases, AI-EES has provided funding in early project work, and projects apply to CCEMC for the funds needed to demonstration large projects.

AI-EES is the connector between government direct investments in energy and environment and the indirect investments funded by the CCEMC. This ensures that AI-EES, CCEMC and government are strong collaborators in technology demonstration.

e. Campus Alberta and Alberta Innovates

AI-EES has worked closely with Campus Alberta and Alberta Innovates since their inception. These organizations are important players in building research capacity in Alberta.

f. Strategic Alignment with Alberta Research and Innovation Plan

AI-EES works in support of the Alberta Research and Innovation Plan. This plan has three strategies: Building Research Capacity; Focusing on Targeted Areas; and Developing a Dynamic and Aligned Learning and Research and Innovation System.

g. Industrial Associations and Non-Government Organizations (NGOs)

AI-EES is a member of a variety of associations[8] and provides leadership by sitting on their boards. Staff members regularly interact with their peers in a variety of meetings, technology workshops and conferences.

h. Industry

Most of AI-EES projects have funding from industry partners. AI-EES staff work closely with

[8] Examples include Alberta Chamber of Resources, Petroleum Technology Alliance of Canada, Carbon Management Canada and Alberta Water Council

industry in developing ideas for research and innovation projects and in launching co-funding opportunities. AI-EES Board members have significant industry and business experience and provide strategic leadership and oversight. Board members are often called upon by provincial, national and international organizations to provide advice and are in a position to influence industry and government directions in research and technology.

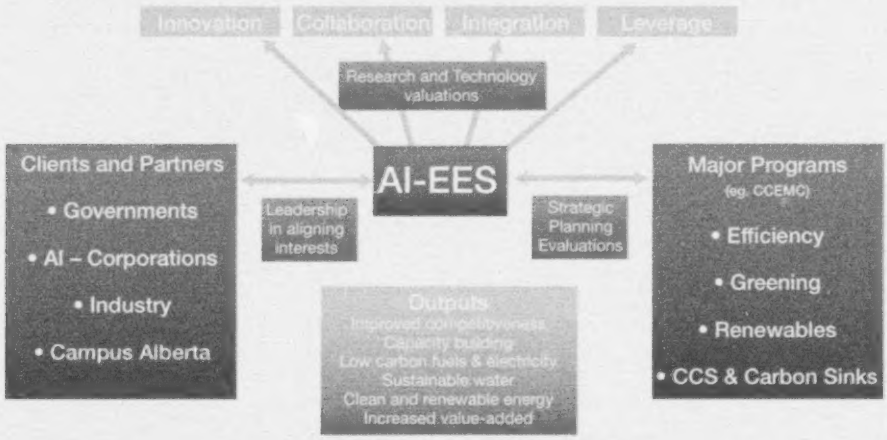

Figure 5: *Illustrating the* central *role that AI-EES plays as the technology arm of both the CCEMC and Alberta government and as a major force in promoting innovation, collaboration and an integrated approach to research and technology.*

MAJOR BUSINESS STRATEGIES FOR 2013-14

- **Development of an Inclusive Innovation Dialogue pilot plan** (Figure 6 below)
- **Expanding national and international collaboration in support of Alberta's proposed Canadian energy strategy** currently taking place through CCEMC, AI-Corporations, the Canadian Oil Sands Innovation Alliance (COSIA), the Canadian Clean Power Coalition (CCPC), Natural Resources Canada (NRCan), Ontario (Bowman Center), Pacific Northwest National Lab, and Canadian Water Network
- **Expanding capacity development** by linking AACI Program, Tshinghua University – University of Alberta, C5MPT, Carbon Management Canada, Chairs Program, COSI, Alberta Helmholtz Initiative, and AI-EES-NRCan Upgrading Program
- **Catalyzing game-changing technology** through sustained investments and scouting for new technology and partners
- **Risk Sharing** by undertaking pilots and pre-commercial scale demonstrations sharing the risks of developing new technologies and removing IP barriers to collaboration

- **Balanced portfolio by** focusing on the key technical, environmental, economic challenges to accelerate the realization of the solutions and the opportunities and advance key platforms that continue to build Alberta's natural advantage
- **Empower government** by helping inform Alberta Ministries' strategic planning and policy development.

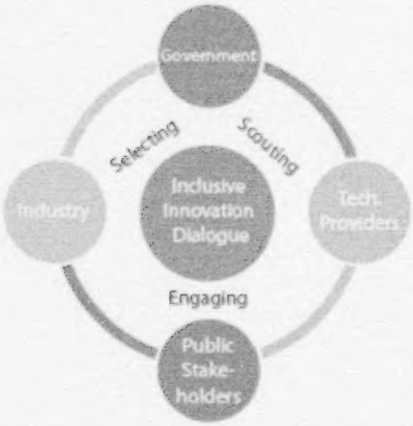

Figure 6: *Illustration of the Inclusive Innovation Dialogue process.*

INCLUSIVE INNOVATION DIALOGUE

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In our 2012-2016 Strategic Business Plan and in developing what we called "the Improved AOSTRA Model", we recognized the importance for understanding as well as tackling the complex social and environmental issues in the context of the provincial interests.

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encourage mature, constructive conversation amongst the public, First Nations and non-government organizations based on the science of solutions. The overall objective is to support and enhance the legitimacy and the practicability of policy and regulatory requirements through better integration of public values based on the best available technical knowledge.

GOALS, OUTCOMES AND PERFORMANCE MEASURES

INVESTMENT PRINCIPLES

AI-EES is developing a number of new measures for the 2013-16 Business Plan. Alone, each measure is an indicator of success. Taken together, they build a story that shows we are acting on our principles. AI-EES does not do research, nor build physical plants. We contribute to the innovation agenda in the province by supporting the work of industry and academia; and by commissioning technical studies to inform policy.

The heart of AI-EES' operations is to create and invest in initiatives that help AI-EES fulfill its mandate, which in turn supports the governments' efforts to achieve its vision of Investing in Families and Communities, Advancing World-Leading Resource Stewardship and Securing Alberta's Economic Future.

AI-EES works with partners to develop the projects that will promote Alberta's interests. Projects are evaluated by a committee of AI-EES scientific personnel to determine how well the project meets the criteria for funding. The following form the key principles for AI-EES investments:

- Secure maximum value from Alberta's energy resources, including reducing the global vs. Alberta price differential
- Provide science-based information to inform policy
- Innovation Capacity
- Improve environmental performance, including water resources sustainability
- Accelerate commercialization in Alberta
- Increase deployment of clean energy
- Transfer technology to the appropriate sectors

Tracking performance against these principles is the prime indicator of our success in advancing to our long term targets.

The development of specific performance measures for these principles is new to AI-EES in 2013. Estimates for 2012-13 are included for reference, but targets for future years will be developed after data has been collected for at least three years.

Building on the above principles, we will measure our performance in the following categories:

- Secure maximum value
- Inform policy
- Expand innovation capacity
- Improve environmental performance
- Accelerate commercialization

SECURE MAXIMUM VALUE

Goal Statement: AI-EES invests in projects that will secure the maximum value for Alberta's resources.

	2012-13 Estimate	2013-14 Target	2014-15 Target	2015-16 Target
Number of initiatives that will enhance the value of Alberta's resources	35			
Total AI-EES commitment to these initiatives	$14.3 m			

Initiatives include: upgrading, operational efficiency, pipeline technologies, clean coal, market studies, and use of by-products.

INFORM POLICY

Goal Statement: AI-EES works with government of Alberta departments and agencies to determine their research needs and to co-develop projects that will inform policy and Ministries strategies.

	2012-13 Estimate	2013-14 Target	2014-15 Target	2015-16 Target
Total number of active Technology Informing Policy (TIP) Projects each year	9			
Total AI-EES investment in active TIP projects each year	$2.8 m			
Total government investment in active TIP projects each year (not including AI-EES)	$1.6 m			

This measure is aimed at our collaborative work with government and government agencies.

EXPAND INNOVATION CAPACITY

Goal Statement: AI-EES supports innovation by academia.

	2012-13 Estimate	2013-14 Target	2014-15 Target	2015-16 Target
Number of Chairs	9	8	8	8
Number of Initiatives at Post-Secondary Institutions	25			
Total investments (Chairs and Initiatives) at Post-Secondary Institutions	$36.8 m			

This measure indicates the investments at post-secondary institutions in applied R&D with industry. It is also an indicator of a proxy for the training of highly qualified personnel, as much of the actual work on the initiatives and chairs is performed by students and post-doctoral fellows that will meet the future employment needs of industry.

IMPROVE ENVIRONMENTAL PERFORMANCE

Goal Statement: AI-EES invests in projects that improve environmental performance in the development of all energy resources.

	2012-13 Estimate	2013-14 Target	2014-15 Target	2015-16 Target
Number of initiatives that improve environmental performance in the development of all energy resources	10			
Total AI-EES commitment to these initiatives	$4.0 m			

Initiatives include: studies on fracturing, metal and organic depositions, air quality studies, environmental monitoring and reclamation.

Goal Statement: AI-EES maintains a balanced portfolio of projects in its three strategic areas.

The initiatives in the **Water and Environmental Management** area directly address environmental performance. The 44 active initiatives address carbon capture, CO_2 purity and monitoring, effects of development on water, reclamation, biodiversity, oil sands process water and tailings. The 20 active projects in the **Renewable and Emerging Resources** area also have a strong environmental component to them as well. These projects include energy efficiency, in situ coal gasification, use of waste materials to create energy, development of energy storage for wind generators and other alternate energy ideas. Due diligence has been done on the 36 active projects in **Energy Technologies** to ensure the ideas proposed will improve environmental performance by:

- Reducing the footprint of oil sands operations
- Looking for uses for oil sands by-products instead of simple storage

- Working with producers to use CO_2 in enhanced oil recovery.

AI-EES also tracks the balance of projects by strategic area. The chart below shows our 100 active projects and the total $136.2 million investment in innovation and the relative percentage of funding to each strategic area. AI-EES maintains a balanced portfolio across the three areas.

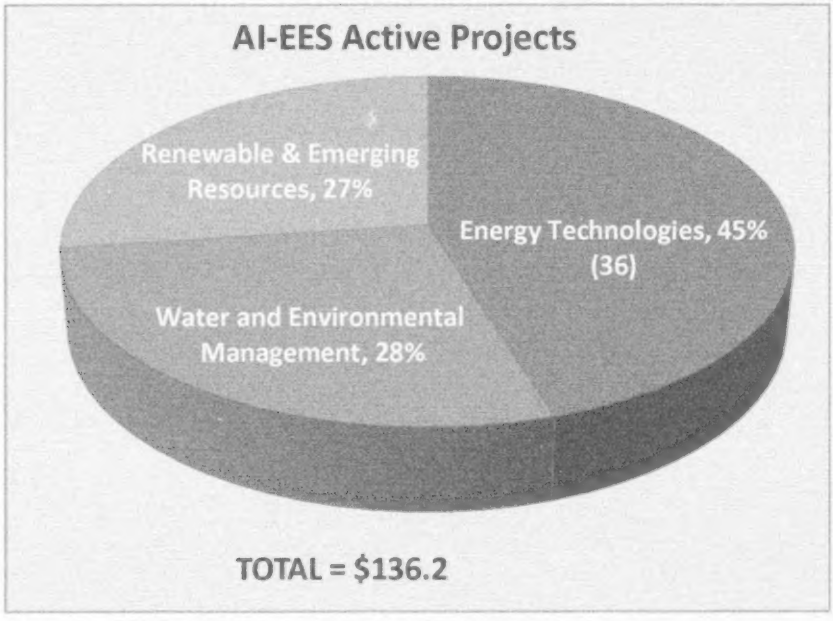

Figure 7: Percent of total committed funds invested in each strategic area. Number of projects in each area is in brackets.

ACCELERATE COMMERCIALIZATION

Goal Statement: AI-EES invests in a balanced portfolio of projects along the Technology Readiness Levels (TRL) scale.

AI-EES evaluates projects and tracks their success by assessing their TRL relative to progress and milestones achieved (see Figure 8). This allows AI-EES to maintain a balanced portfolio of projects along the pathway towards commercialization; keeping a number of projects entering the spectrum at the early ideas stage and developing technology transfer strategies when projects move closer to commercialization.

As of February 1, 2013, the 100 active projects in the AI-EES portfolio were analyzed and placed on the simplified TRLs, going from research to development to pilot to demonstration to commercialization to widespread adoption. AI-EES, as the project manager for projects of the

Climate Change and Emissions Management Corporation (CCEMC), also tracks the 46 active projects in the CCEMC portfolio. The chart shows a balanced portfolio with AI-EES projects mostly at the earlier stages of development and CCEMC projects towards the commercialization end. Some projects originally developed with AI-EES and that fit the CCEMC mandate, have transitioned to being funded by the CCEMC to see them through the more expensive stages of pilot and demonstration.

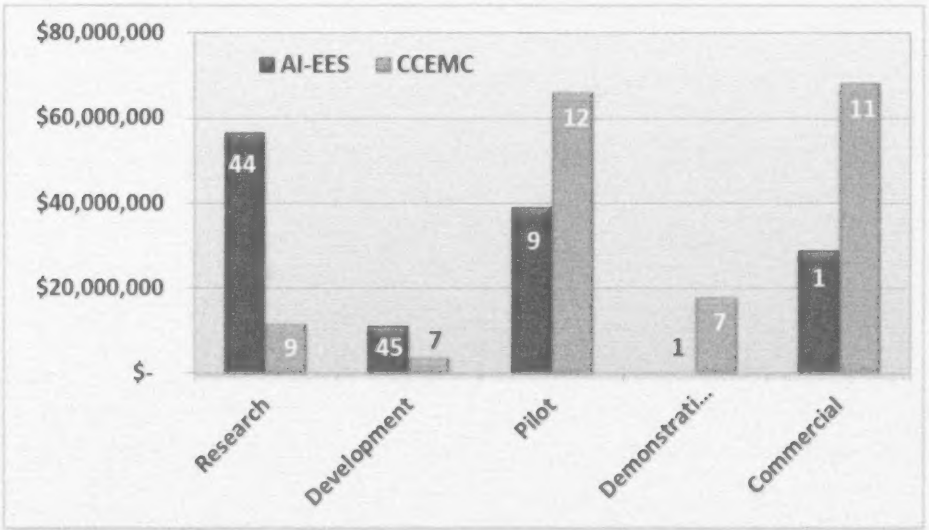

Figure 8: *Mapping AI-EES' active projects along the innovation path. Number of projects in each level is noted on the bar.*

In 2012-13, our research staff of 12 FTE's collectively managed 146 projects with a total value of $304.3 million dollars. Of these 146 projects, 46 of them -- with a value of $168.1 million -- are managed by AI-EES on behalf of the CCEMC; and the remaining 100 projects -- with a total commitment of $136.2 million -- are funded by AI-EES. The management of the projects includes activities such as advising applicants on their application, evaluating the projects, preparing summary material for the Board, negotiating legal agreements, participating in all consensus and ranking meetings, reading all project reports, analyzing and evaluating the reports for completeness, preparing all materials for payment of funds, final closeout of the project, summarizing the key findings, preparing briefing materials for public announcements and ensuring that the knowledge is being transferred to industry and government. While doing this, the staff are also developing new lines of research for consideration, ensuring they are up to date on the latest developments in their fields and monitoring new developments around the world.

OVERALL ACHIEVEMENT OF LONG TERM TARGETS - BUSINESS TRACKING

Our vision is that Alberta leads the world in developing innovative energy and environmental technologies that build on our natural advantages. To achieve this outcome, we have established long term targets aligned with provincial strategies. These targets serve to focus our initiatives on achieving Alberta priorities.

AI-EES uses the ProGrid® methodology to measure overall progress towards the long term 2030 goals.

Progress within each strategic area is measured annually against a set of criteria. Taken together, the portfolio of projects within each area is rated against the "AI-EES Assets" and the "AI-EES Impact" achieved by AI-EES investments. The summary grid shown below illustrates that AI-EES is making progress towards the long term goals.

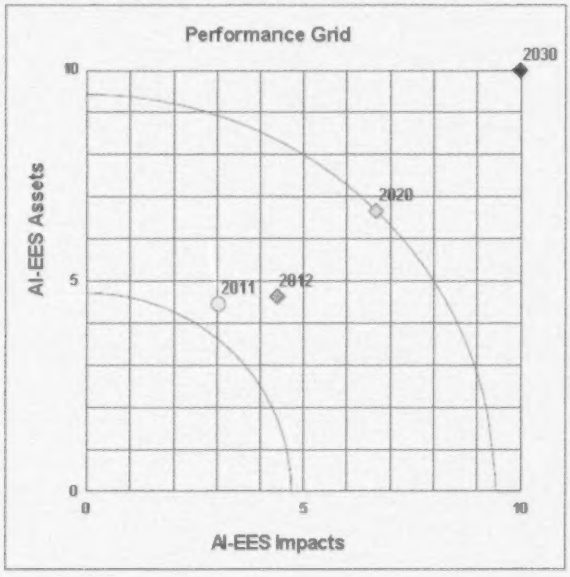

Figure 9: *ProGrid Summary Performance Grid showing the progress that is being made to reach the 2030 goals.*

In 2011-12, AI-EES made progress toward the 2030 goals that we have established. Progress can largely be attributed to our performance in Environmental Management in the three targeted areas of oil sands tailings and water, enhanced ecology, and carbon capture and storage.

RESEARCH AND INNOVATION INITIATIVES

2030 GOALS

Our vision is that Alberta leads the world in developing innovative energy and environmental technologies that build on our natural advantages. To achieve this outcome, we have established long term targets aligned with provincial strategies. These targets serve to focus our initiatives on achieving Alberta priorities.

AI-EES Management's Technology Goals by 2030		
Oil sands and Value Added	**Clean Energy and Renewables**	**Water/Land**
▪ Develop pipeline and refinery ready bitumen products to improve value in global refineries by $6-10 billion per annum compared to 2012	▪ Renewable resources supply 20% of Alberta's power generation and result in a 15% reduction in greenhouse gas emissions for this sector	▪ Achieve the goals of the Government of Alberta Water for Life Strategy delivering best-available science and knowledge to policy directions
▪ Develop and demonstrate technologies that enhance the efficiency of upgrading and processing of bitumen by 20%	▪ Develop and demonstrate technologies that reduce emissions by 50% per unit of bitumen recovery	▪ A 50% reduction (2010 as base) in fresh water use intensity in the energy sector by 2030
▪ Develop and demonstrate technologies that support increasing recoverable heavy oil by 20% over current methods	▪ Alberta has a strong and diversified renewable energy manufacturing sector which provides high-paying technical jobs, especially in rural areas	▪ A 30% reduction (2010 as baseline) in water use intensity in the municipal sector by 2030
▪ Freshly generated oil sands tailings meets ERCB Directive 074; legacy MFT volumes are reduced by 30%	▪ Best technologies and practices available for Alberta to reduce GHG by 100 Mt/yr by 2030 compared with 2008 BAU case	▪ Progressive reclamation occurs at rates equal to disturbance
▪ Total MFT volume has been stabilized and on the decline beyond 2030	▪ At least one clean carbon/coal commercial demonstration facilities with minimum impact on the environment and net GHG emissions	▪ Restored lands support sustainable ecosystems that are resilient to disturbance

AI-EES Management's Technology Goals by 2030		
Oil sands and Value Added	**Clean Energy and Renewables**	**Water/Land**
▪ Develop, demonstrate and incorporate key technologies to enable economically viable and environmentally sustainable recovery of tight oil and gas	▪ Alberta is a global leader in underground coal gasification (UCG) and at the leading edge of energy-related nano-technology, as well as other enabling technologies	▪ Species at risk in Alberta are not increasing in number and measures of biodiversity intactness indicate sustainable land practices are in place

The chart below shows the various initiatives that are in progress or being contemplated; the incentive for undertaking these innovations; and the expected outcomes of each item. These initiatives are designed to move us closer to 2030 goals and collectively they are intended to position Alberta as a global energy and environment leader.

Initiatives	Incentive	Expected Outcomes
Energy Technologies		
▪ Development and demonstration of non-aqueous extraction methods for oil sands	▪ Water scarcity and management ▪ Improved Environmental performance ▪ Reduced land disturbance and destruction of habitat	▪ Reduction in water use, energy consumption, and tailings in oil sands mining operations
▪ Development and demonstration of non-steam thermal recovery methods for in-situ bitumen	▪ Water scarcity and management ▪ Elimination of water treatment and disposal requirements ▪ Reduction of greenhouse gases	▪ Substantial reduction in water use, natural gas consumption, facility footprint, and emissions ▪ Access to intermediate depth, shallow, thin, and carbonate reservoirs
▪ Demonstration of integrated recovery and field upgrading application	▪ Reduce/eliminate the need for diluents ▪ Effective use of transportation ▪ Increase value and suite of marketable product	▪ Reduction in diluent requirements and improved transportation efficiency ▪ Capture ready source of CO_2 for storage or reuse ▪ Value addition from low value feedstock
▪ Development and demonstration of clean	▪ Energy security ▪ Competitive power prices	▪ Utilization of low value carbon feedstocks to

Initiatives	Incentive	Expected Outcomes
carbon/coal technology	▪ Increase value and suite of marketable products ▪ Safeguard future of Alberta's coal industry	produce value-added products ▪ Development of new petrochemical opportunities ▪ Improved energy efficiency ▪ Capture ready source of CO_2 for storage or reuse
▪ Catalyst Development	▪ Ability to sustainably produce resource ▪ Enhance market competitiveness	▪ Improved efficiency ▪ Improved quality and value of bitumen derived streams
▪ Support of Fundamental Tight Oil and Gas Technology Research		▪ Improved reservoir characterization and modeling ▪ Improved drilling and completion techniques
Water and Environmental		
▪ Water Resources Sustainabilit Al-EES is investing up to $10 million dollars in projects in three focal areas: Water Security, Risk and Vulnerability; Watershed Stewardship and Ecosystem Management; Increased Conservation, Efficiency and Productivity	▪ Water allocation and availability in Southern Alberta ▪ Climate Change and Variability leading to further water scarcity ▪ Water quality in rural areas ▪ Eutrophic lakes ▪ Increased industrial and oil sands development ▪ Shale gas and tight oil	▪ Water quality is maintained or enhanced ▪ Resources are conserved to maintain healthy aquatic ecosystems ▪ Demand for water in reduced ▪ Water use productivity is increased ▪ Water efficiency is improved ▪ Process affected water can be treated and safely released to environment
▪ Integrated land management and biodiversity conservation: to improve the understanding and practices in integrated land management and biodiversity conservation	▪ Disturbance is outpacing reclamation in oil sands region ▪ Habitat fragmentation ▪ Lack of baseline data ▪ Concern regarding ecosystem and human health	▪ The footprint associated with energy production is reduced during development ▪ Restoration practices enhance the quality of rehabilitated lands ▪ Baseline data is available

Initiatives	Incentive	Expected Outcomes
in oil sands region		to understand reference conditions for biodiversity and ecosystem health
▪ Oil Sands Tailing Reduction: as an outcome of the Oil Sands Tailings Technology Deployment Roadmap, AI-EES are investing in new tailings reduction technologies in collaboration with COSIA	▪ Oil sands tailings volume continues to increase. The industry has difficulties to meet the requirement of ERCB Directive 074 ▪ Tailings Water is toxic and needs to be contained	▪ Freshly generated oil sands tailings meets ERCB Directive 074; legacy MFT volumes are reduced according to the TMF ▪ Tailings deposits meet terrestrial and wetland reclamation criteria. ▪ Tailings water can be treated for safe release
▪ Over the Carbon Capture Barrier: focusing on developing carbon capture technologies that reduces CCS cost and enables CO_2-EOR in Alberta	▪ Carbon capture cost too high for CCS implementation ▪ Currently only small CO_2-EOR operation in Alberta ▪ No meaningful CO_2 utilization technology in sight besides CO_2-EOR	▪ CO_2 capture technologies are made available for various CO_2 sources ▪ Reduce CO_2 capture cost to between $30 and $50/tonne ▪ CO_2-EOR is taking place on commercial scale in Alberta ▪
Renewable & Emerging		
▪ Underground coal gasification	▪ New technologies (e.g., linear and parallel Controlled Retraction Injection Point (CRIP), Ergo energy) have yet to be field tested in Alberta and elsewhere. ▪ In situ gasification modeling is at an early stage. ▪ Policy and regulation development requires good field data and modeling ▪ Environmental consequences need further investigation	▪ Value-generation from deep coal resources which are not mineable. ▪ Low-cost syngas could provide feedstock for several sectors (power, hydrogen, liquid fuels and petrochemicals)

Initiatives	Incentive	Expected Outcomes
▪ Support the development of a vibrant waste utilization industry that would contribute to Alberta's supply of renewable energy and economic diversity through the production of bioenergy and novel value-added products	▪ Bio-products more expensive that fossil fuels – unless proven otherwise ▪ Technologies need to be scaled up and demonstrated with Alberta feedstocks ▪ Environmental drivers for renewable energy have still to be validated	▪ Reduction in greenhouse gas emissions. ▪ Lack of infrastructural and technical support for the industry ▪ Need for decentralized energy, rural jobs. ▪ Reduced need for landfills. ▪ Diversify the rural economy and create high quality jobs in rural communities. ▪ Encourage recycle plant nutrients and sustain our agricultural land and utilize Alberta's marginal land
▪ Harness geothermal energy from existing oil and gas wells to generate heat and power	▪ Lack of comprehensive geothermal database, mapping tools, and technology roadmap ▪ Economics need to be validated. ▪ Geothermal resources in Alberta push the lower temperature limits of Organic Rankine cycle technology	▪ Recovery of renewable geothermal energy by making use of previously drilled wells ▪ Reduce GHG emissions by augmenting fossil fuel consumption ▪ Reduce the need for natural gas and coal for power generation
▪ Energy storage: Support the development of technologies that would result in the cost-effective energy storage for intermittent renewable electricity and mobile applications, leading to a vibrant energy storage manufacturing sector in Alberta	▪ Low natural gas price reduces cost competitiveness of energy storage to provide grid stability for intermittent renewable electricity ▪ Much research at early stages of technology readiness ▪ Lack of policy and regulations to facilitate the connection of energy storage to Alberta's	▪ Greater deployment of wind and solar power in Alberta ▪ Cost competitive electric and electric-hybrid vehicles ▪ Enabling reduction of GHG emissions from renewable electricity ▪ Economic activity from a new manufacturing industry in Alberta

Initiatives	Incentive	Expected Outcomes
	electrical grid	
▪ Hydrogen production pathways: The technologies and expertise developed in hydrogen production, separation, storage and transport will strategically position the province in a future Hydrogen Economy	▪ It is strategically imperative that Alberta looks into supplying its hydrogen needs from alternatives and accessible sources such as coal (UCG), renewable (biomass, solar) or nuclear energy	▪ Hydrogen production from sources other than natural gas
▪ Energy Efficiency: Identify the best opportunities for energy efficiency improvements and greenhouse gas reductions	▪ Determine the energy efficiency products, technologies and policies the government encourage	▪ Modeling capability would allow Alberta government departments to investigate policy options quickly ▪ Energy modeling would help policymakers understand the beneficial impacts of the AI-EES program – and help AI-EES and CCEMC optimally direct their investment programs
▪ Nuclear Energy: feasibility of small modular nuclear reactors (SMNR)	▪ SMNRs are more suited to generate electricity and process heat for the oil sands ▪ Novel SMNRs are being commercialized	▪ Lower greenhouse gas emissions from the oil sands

BUDGET AND RESOURCE REQUIREMENTS

(in thousands)	2012-13 Forecast	2013-14 Estimates	2014-15 Target	2015-16 Target
Funding from Enterprise and Advanced Education	16,010	14,385	14,385	14,385
Grants for AIF Centres	1,650	1,040		
Revenue Recognized from AWRI Grant	3,693	6,145	469	
Grant for Water and Tailings Research	4,440	5,060	5,730	
Funding from other GOA Ministries	83			
Funding from other Government Sources	510			
Industry Funding	228			
Revenue earned from CCEMC Services	673			
Grant from CCEMC for SSRB	354	1,246		
Revenue Earned from Licenses and Sales	406	275	425	365
Investment Income	518	312	222	158
Other Revenue	425	273	423	363
Total Revenues	**28,745**	**28,736**	**21,654**	**15,271**
Energy Technologies	6,751	8,990	10,495	11,477
Renewable and Emerging Resources	1,189	4,275	3,725	2,325
Water and Environmental Management	1,251	3,778	2,388	2,047
Water and Tailings	90	5,263	4,703	5,173
Water Resources (AWRI)	3,023	6,096	1,333	508
Total Research	12,304	28,403	22,645	21,531
Program Administration	3,944	4,111	3,867	3,988
Technology Support	2,826	3,351	2,597	2,637
Grand Total Expenses	**19,074**	**35,865**	**29,110**	**28,067**
Net Operating Results	**9,915**	-7,130	-7,455	-12,796
Net Assets Beginning of Year	21,276	31,191	24,061	16,606
Add Net Operating Results	9,915	-7,130	-7,455	-12,796
Net Assets	**31,191**	**24,061**	**16,606**	**3,809**

Research and Innovation (RI) Initiative*	Total 2013-14 Budget ($'000)	Key Outcomes of the Alberta Research and Innovation System		
		Effective Resource & Environmental Management ($'000)	Broadened Economic Base ($'000)	Resilient, Healthy Communities ($'000)
Energy Technologies	8,990	4,495	4,495	
Renewable and Emerging Resources	4,275	1,069	3,207	
Water and Environmental Management	3,778	2,834	945	
Water and Tailings	5,263	1,053		4,211
Water Resources (AWRI)	6,096	1,219		4,877
TOTAL	**28,403**	**10,670**	**8,646**	**9,087**